

D-RAP DIGITAL TWIN ECOSYSTEM OF STEEL PROCESSING

An ecosystem that allows users to interact with models developed at WMG, University of Warwick that explore fundamental metallurgical understanding for industrially relevant applications and our processing facilities.

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Introduction

What do we mean by Digital Twins?

A **verified** digital representation of a physical real world production / test / in-service use case.

Key features

- Multiple levels: multi-physics approach, capturing thermal, mechanical, and/or electromagnetic boundary conditions.
- Microstructural layer is added, predicting phase changes, microstructural evolution and/or final properties.
- Enables process / material optimisation, sensitivities to variations in the system and potential business cases for new approaches to drive and guide physical trials.

What are we trying to achieve?

Create an ecosystem that allows users to interact with models developed at WMG, University of Warwick that explore fundamental metallurgical understanding for industrially relevant applications and our processing facilities.

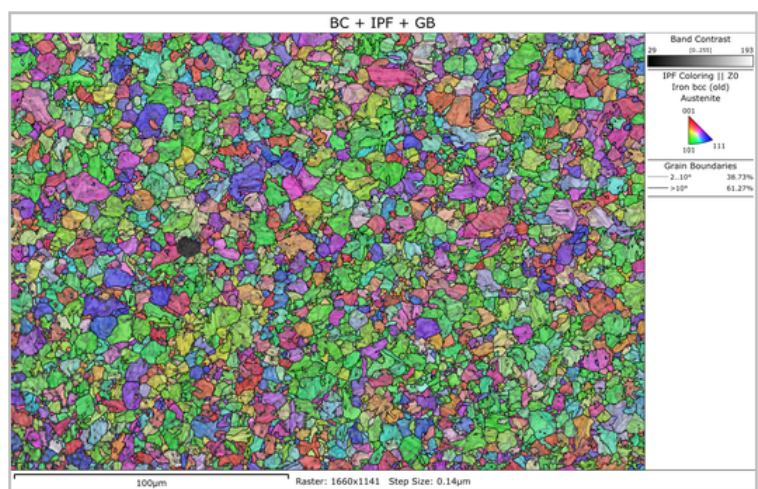
Key objectives

- A way to capture and disseminate modelling activity both on an open-source scale, but also confidentially within research and development partnerships.
- Provide an **educational platform**
- Support users of our lab facilities via models of the equipment, use of case studies which allows in-depth studies and verification of material / process change effects.

Example: Hot Rolling Digital Twin

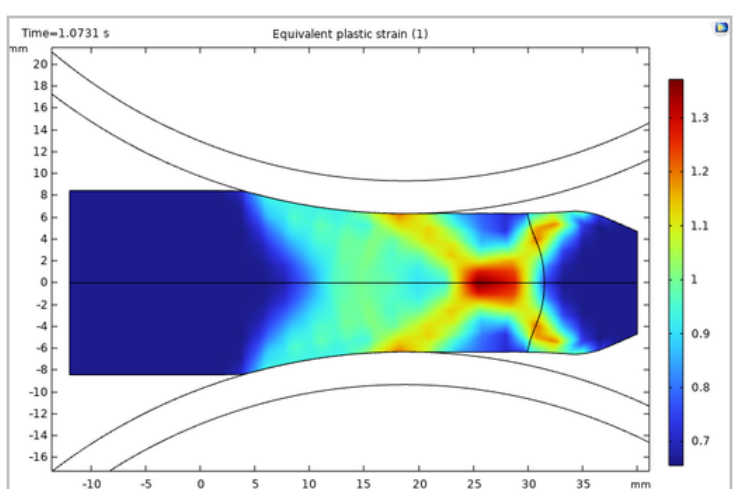
METALLURGICAL INPUT

Metallurgical input (i.e. grain size) informs the starting properties for hot rolling.



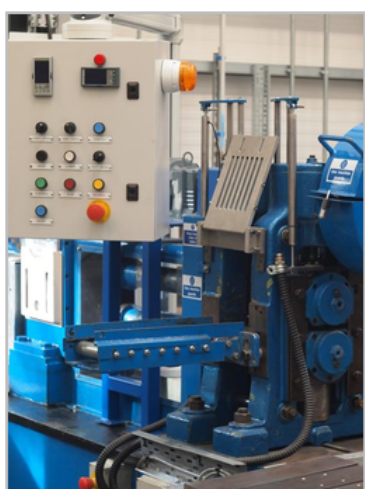
FINITE ELEMENT MODELLING

Finite element modelling provides the thermo-mechanical process history and spatial distribution of metallurgical properties.



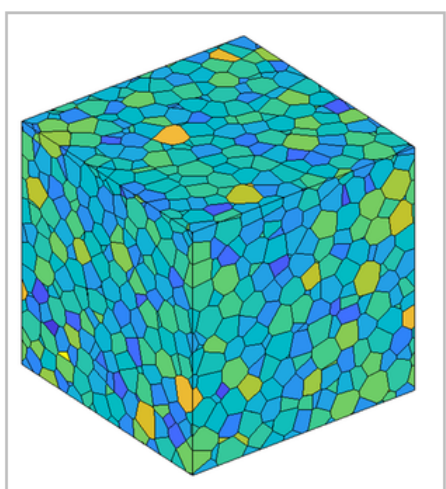
EMPIRICAL CORRELATION

The model is fitted for friction to achieve the strain and microstructure variations through thickness.



METALLURGICAL OUTPUTS

Metallurgical models predict recrystallization and grain growth to give the final grain size.



Provides initial conditions for downstream process twins: CAL (continuous annealing) • ROT (run-out table)

DEPLOYMENT

DIGITAL TWIN ECOSYSTEM

Applications are deployed through COMSOL Server™ as a secure environment for partner interaction.

Key features

- No software license required for end users
- Strict version control and centralized updates
- Customized interfaces tailored to partner needs
- No FEA expertise or detailed knowledge of model development required

FROM MODEL TO INDUSTRIAL IMPACT

Partners can use the ecosystem to:

- Optimize process parameters for a determined output
- Develop new products
- Derisk the introduction of new products into an existing process

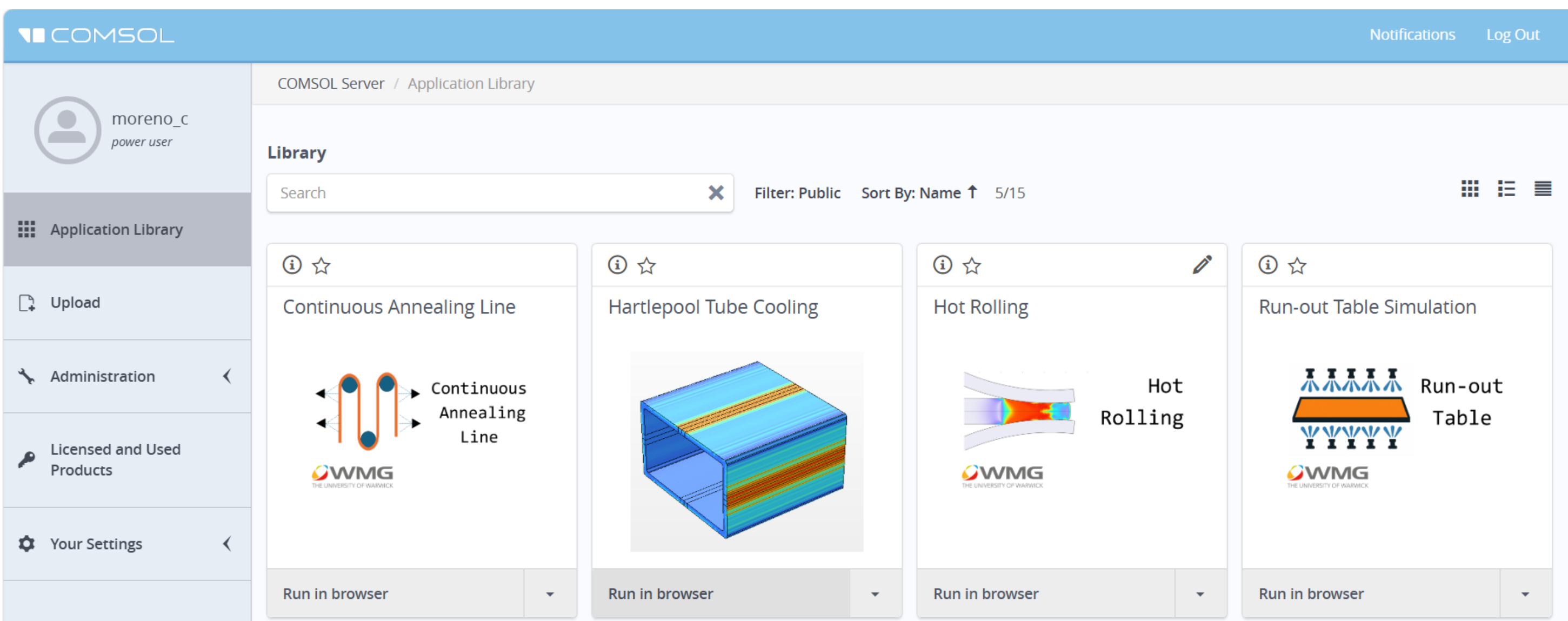


FIGURE 1. WMG COMSOL Server Application Library

REFERENCES